

# **Les faibles scores des prévisions climatiques à court terme dans le Pacifique Nord**

Virginie Guémas

Avec la collaboration de :

Francisco Doblas-Reyes, Fabian Lienert, Hui Du, Yves Soufflet

## Our focus : Seasonal to decadal prediction

-  **Francisco J Doblas-Reyes** : The Head
-  **Hui Du** : *Initial perturbations, sea ice*
-  **Javier García-Serrano** : *AMO, African monsoon*
-  **Virginie Guémas** : *Sea ice, North Pacific skill*
-  **Fabian Lienert** : *regionalisation, PDO*
-  **Melanie Davis** : *climate services*
-  **Danila Volpi** : *initialisation techniques*
-  **Luis Ricardo Rodrigues** : *ENSO, statistical models*
-  **Aida Pintó** : *extremes*
-  **Muhammad Asif** : *EC-Earth*
-  **Oriol Mula-Valls** : *autosubmit developer*
-  **Jordi Peralta** : *system administrator*

We share, on request :

- 1) Autosubmit
- 2) Our decadal hindcasts
- 3) Monthly sea ice restarts
- 4) R diagnostic functions

We run on :

- 1) Marenostrom ( Spain )
- 2) ECMWF
- 3) HECTOR ( Scotland )
- 4) Our local cluster

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# L'exercice de prévision climatique

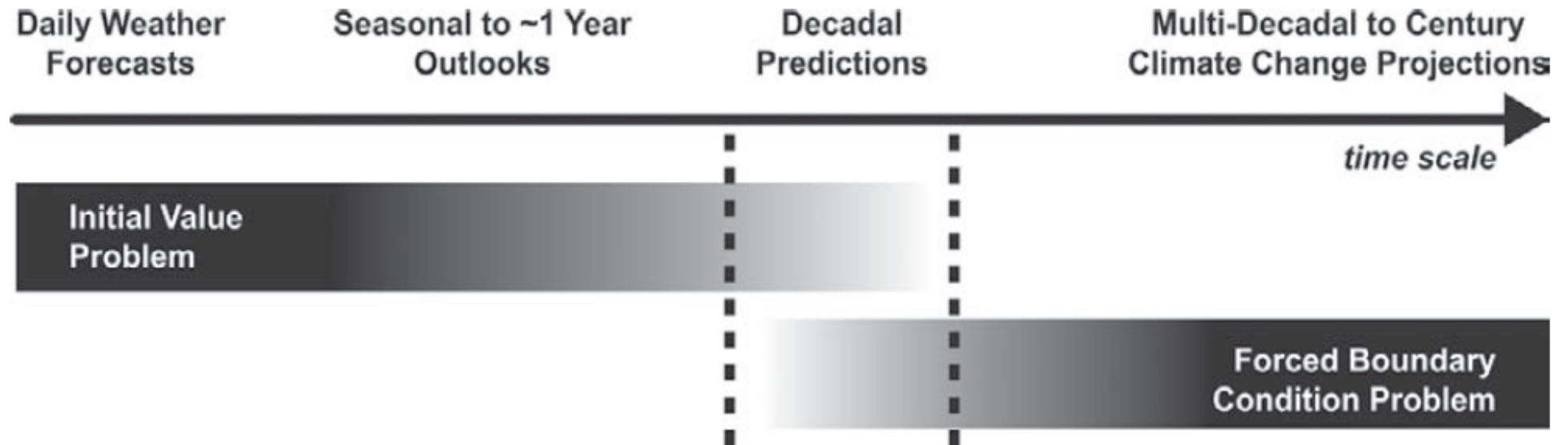
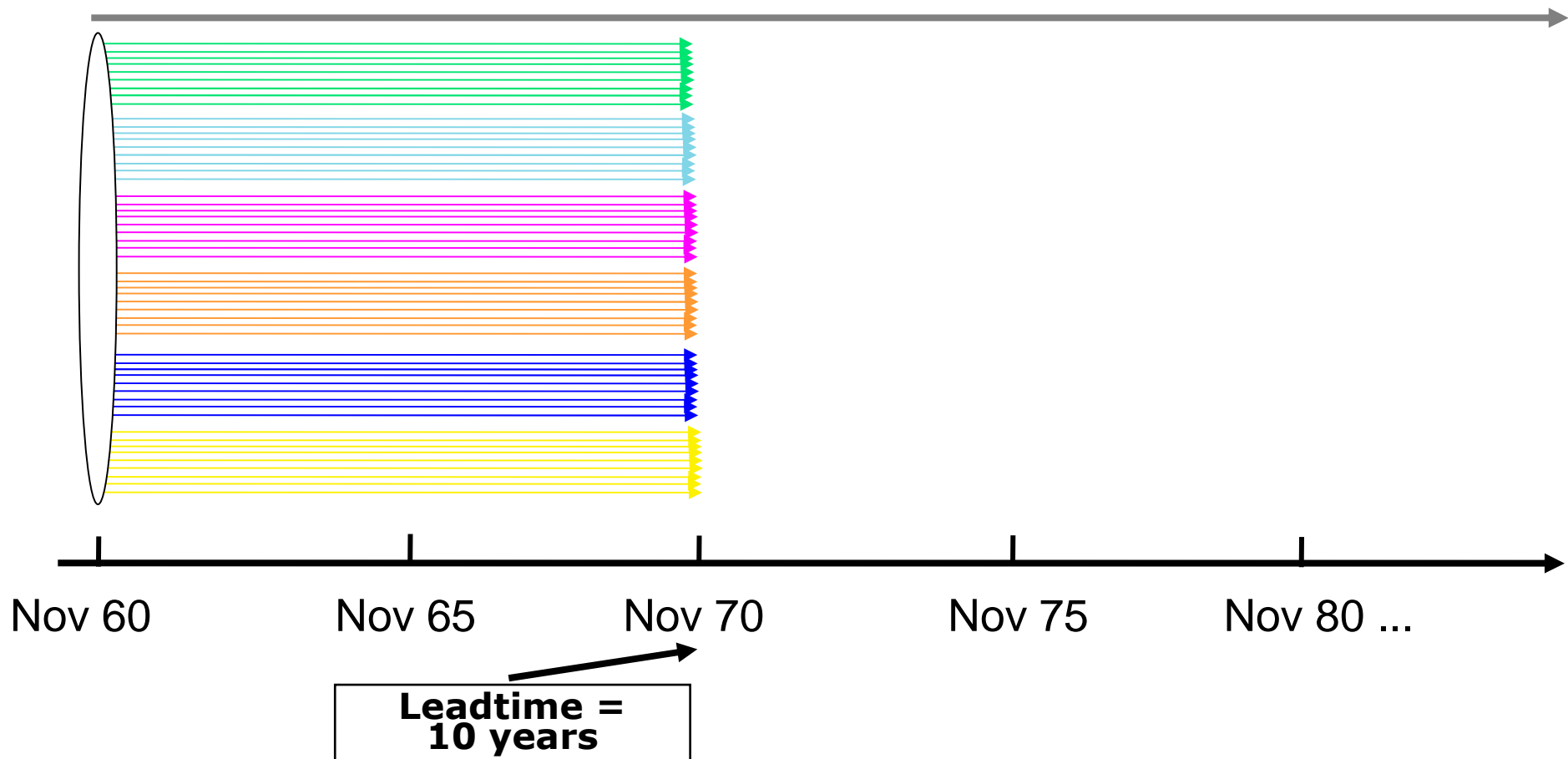


Fig. 2 of Meehl et al. (2009, BAMS)

# L'exercice de prévision climatique

Multi-model ensemble system with coupled initialized GCMs

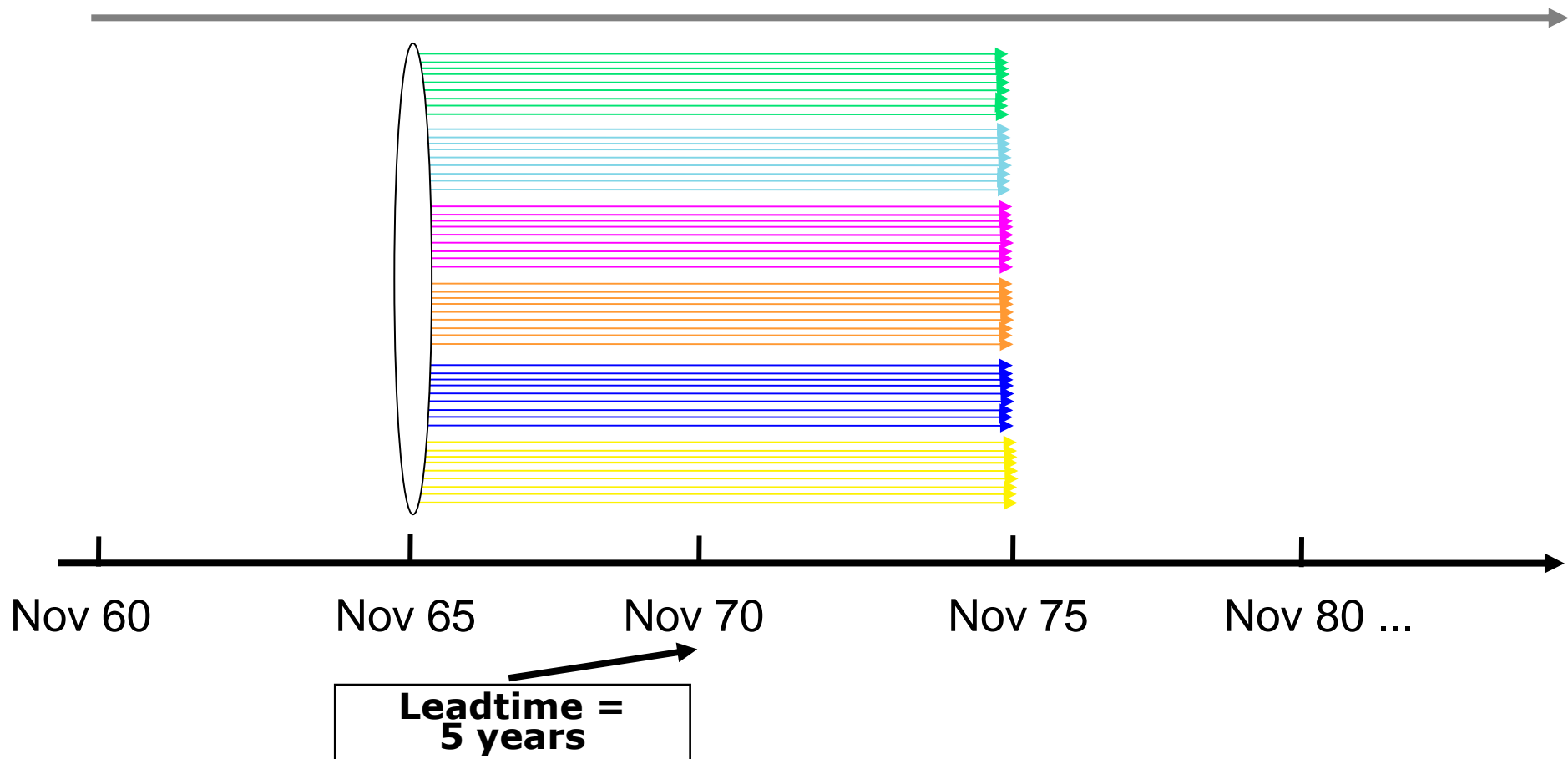
Model 1 Model 2 Model 3 Model 4 Model 5 Model 6 Obs



# L'exercice de prévision climatique

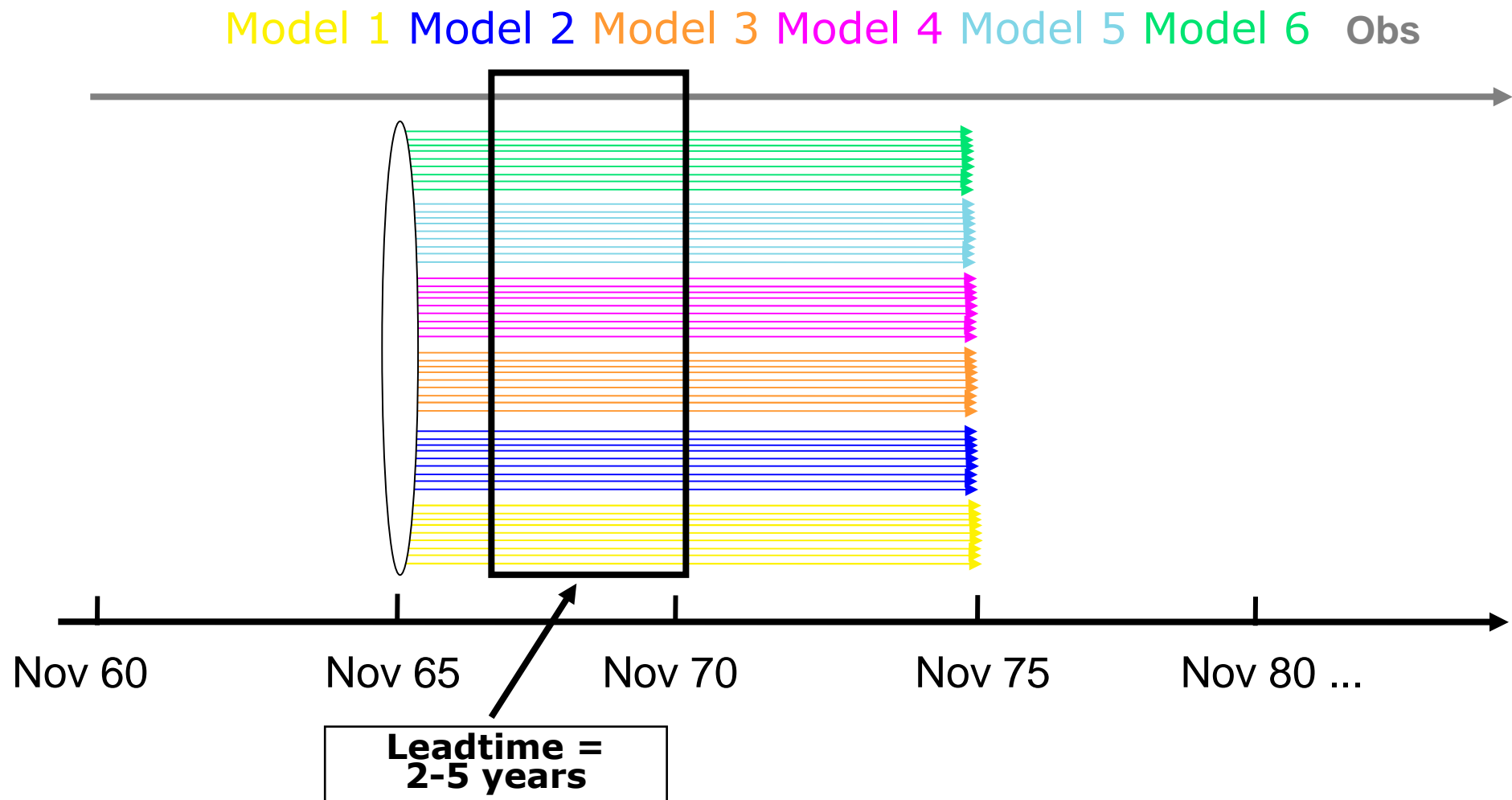
Multi-model ensemble system with coupled initialized GCMs

Model 1 Model 2 Model 3 Model 4 Model 5 Model 6 Obs



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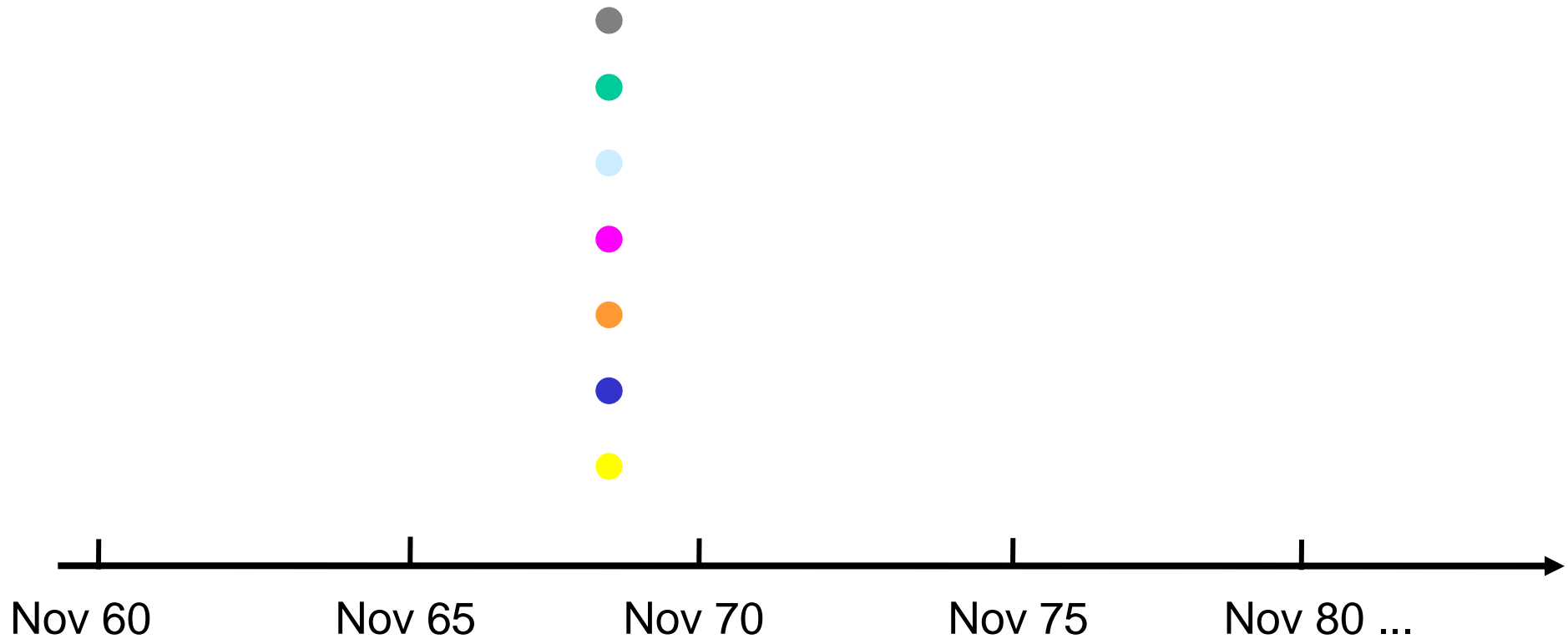
Multi-model ensemble system with coupled initialized GCMs



# L'exercice de prévision climatique

Multi-model ensemble system with coupled initialized GCMs

Model 1 Model 2 Model 3 Model 4 Model 5 Model 6 Obs

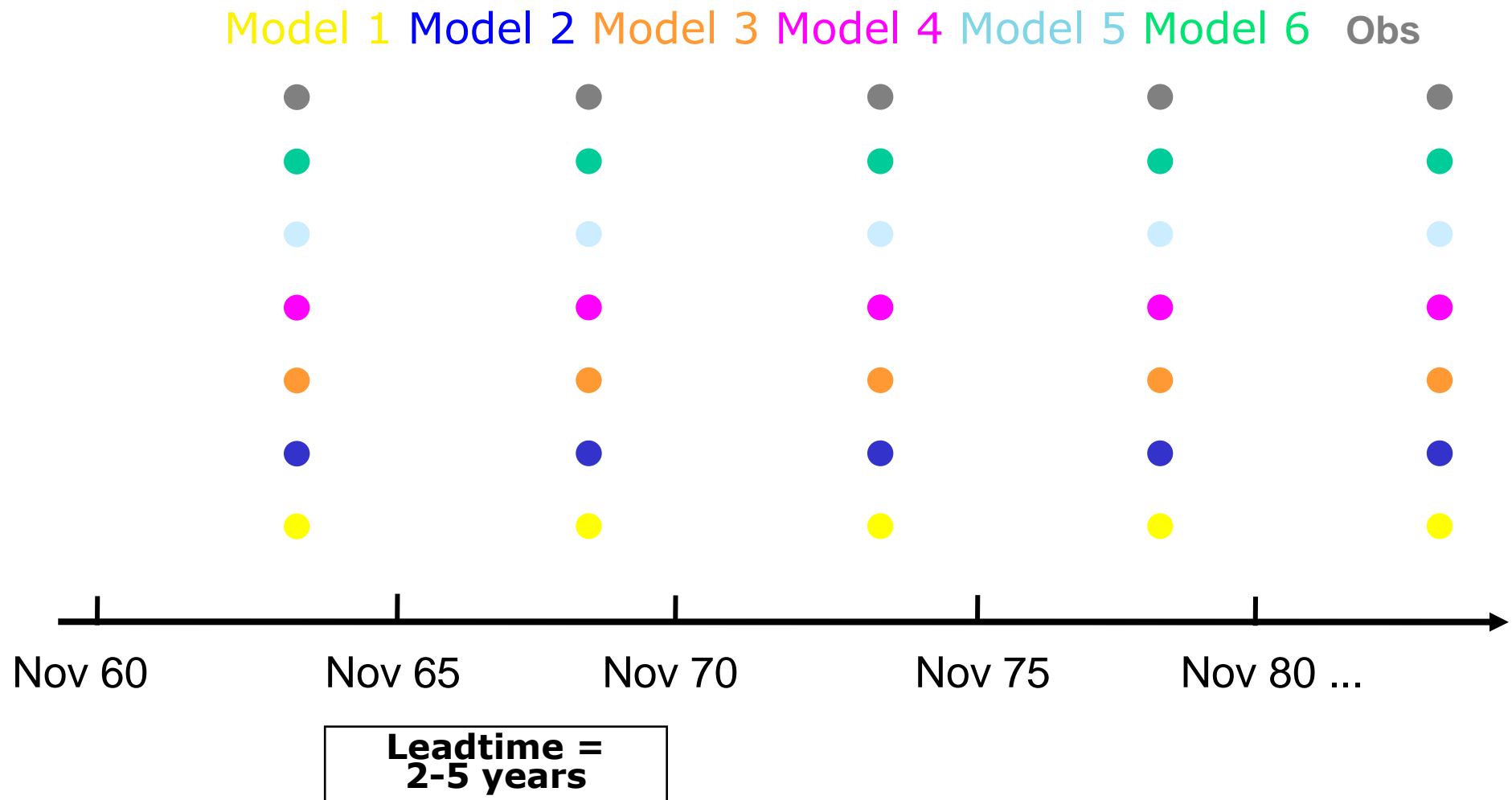


Leadtime =  
2-5 years



# L'exercice de prévision climatique

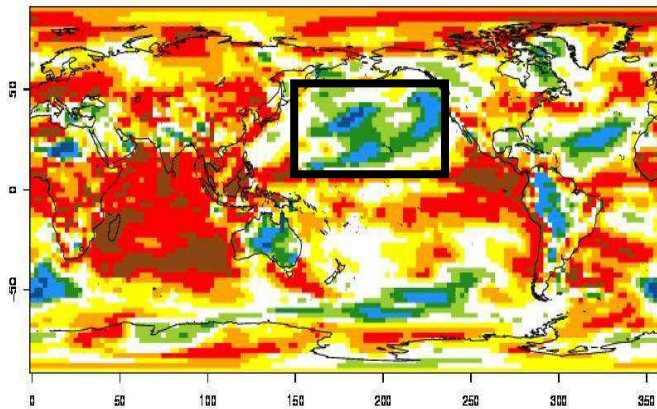
Multi-model ensemble system with coupled initialized GCMs



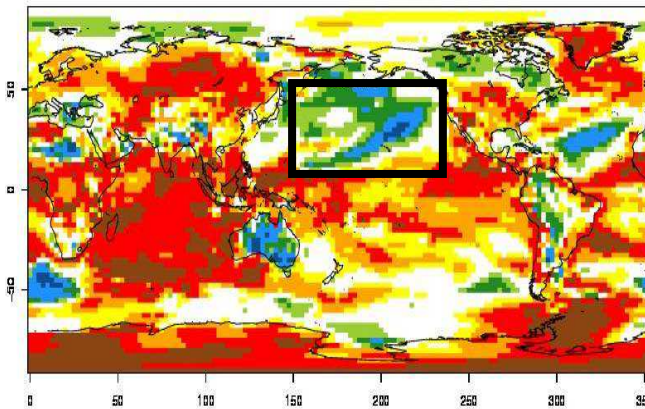
# Scores de température atmosphérique à 2m

Correlation modelled and ERA40 T2M. Leadtimes : 2-5 years

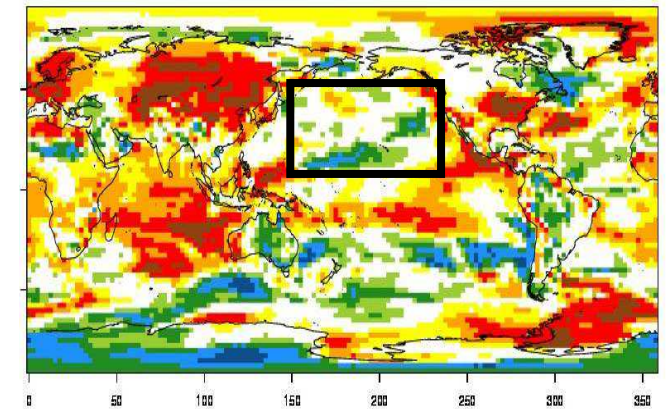
CNRM-CM3



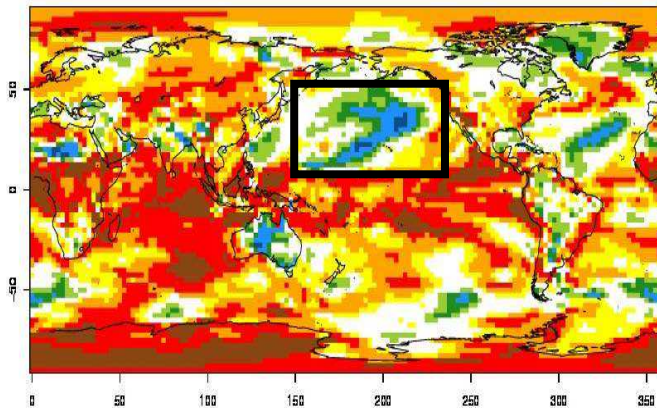
UKMO



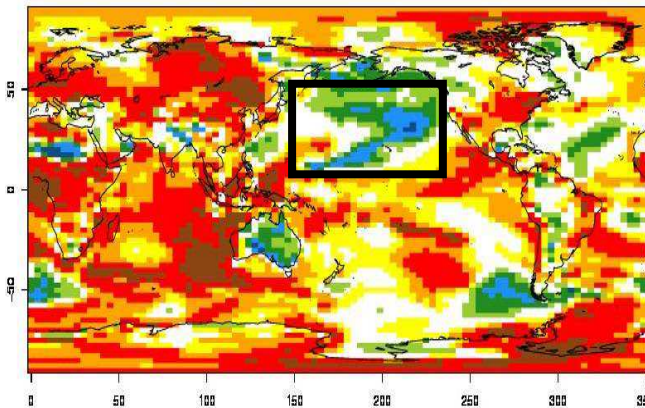
IFM-GEOMAR



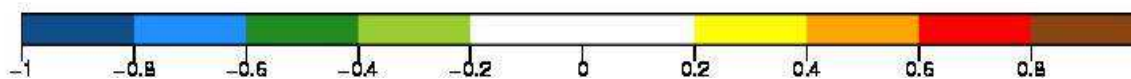
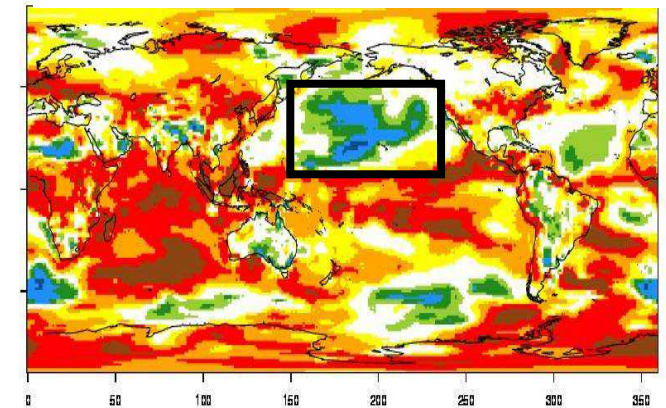
ECMWF



DePreSys



EC-Earth

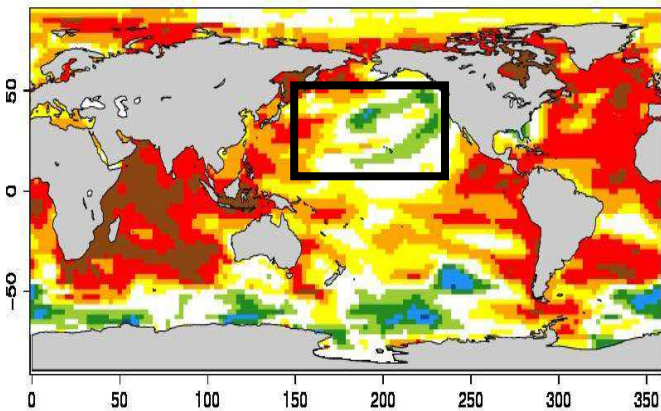




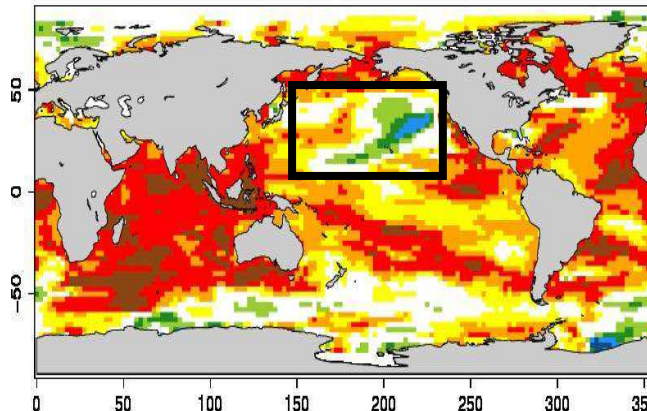
# Scores de température océanique de surface

Correlation modelled and ERSST SST. Leadtimes : 2-5 years

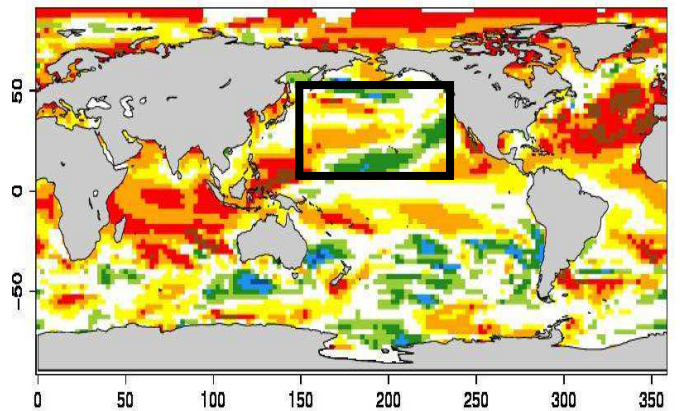
CNRM-CM3



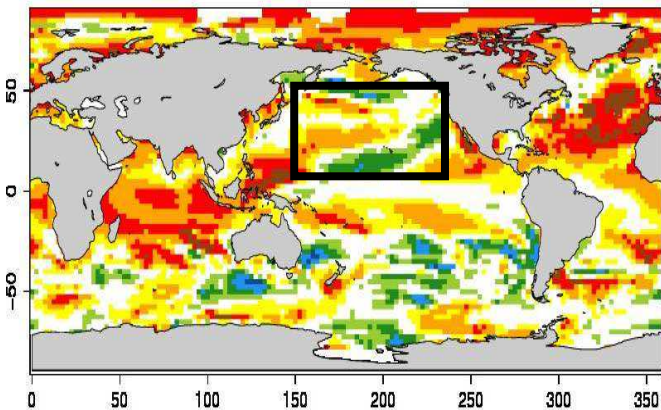
UKMO



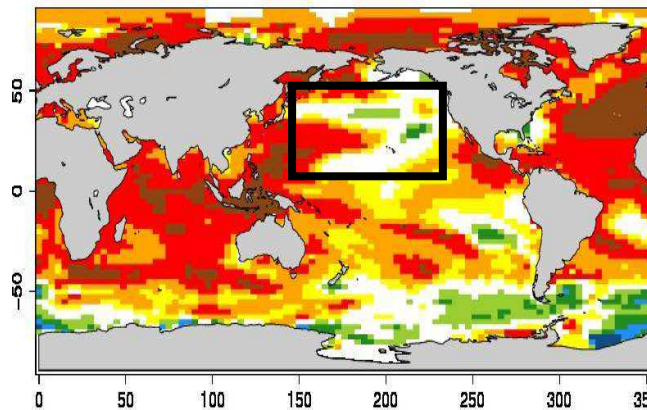
IFM-GEOMAR



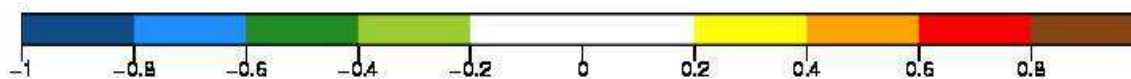
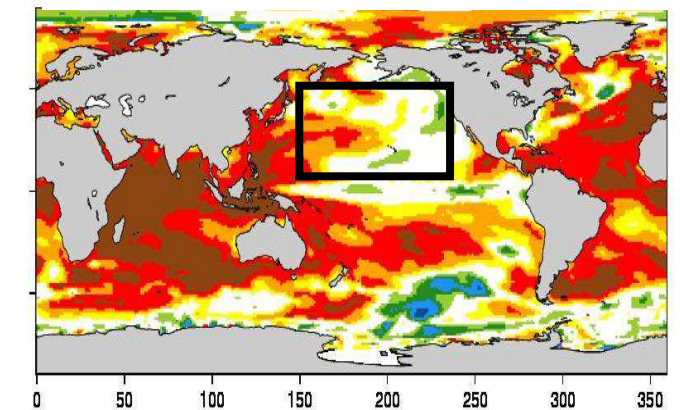
ECMWF



DePreSys

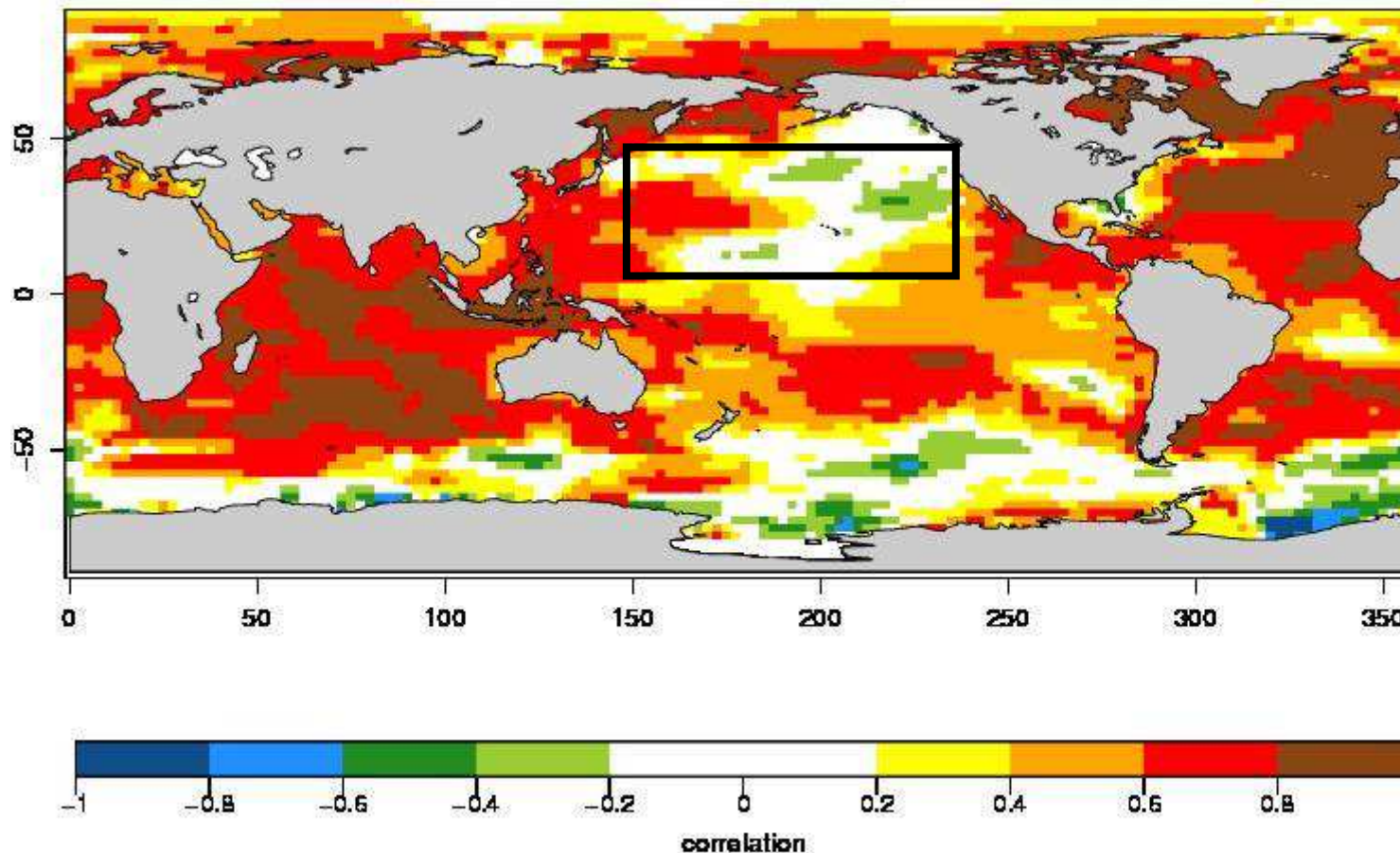


EC-Earth



# Scores de température océanique de surface

Correlation between multi-model ensemble-mean and ERSST SST

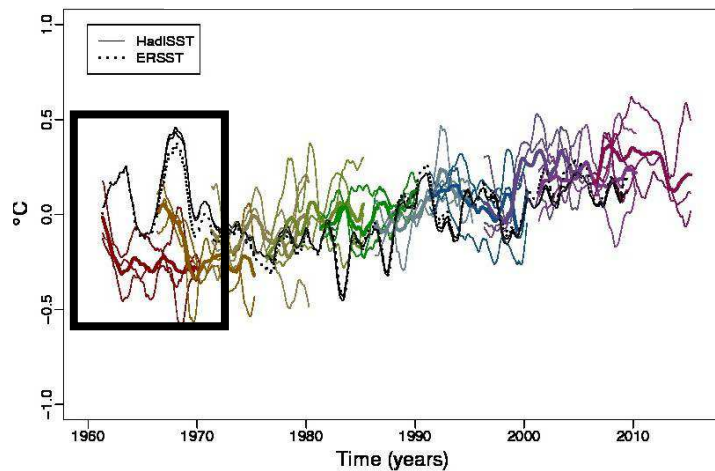




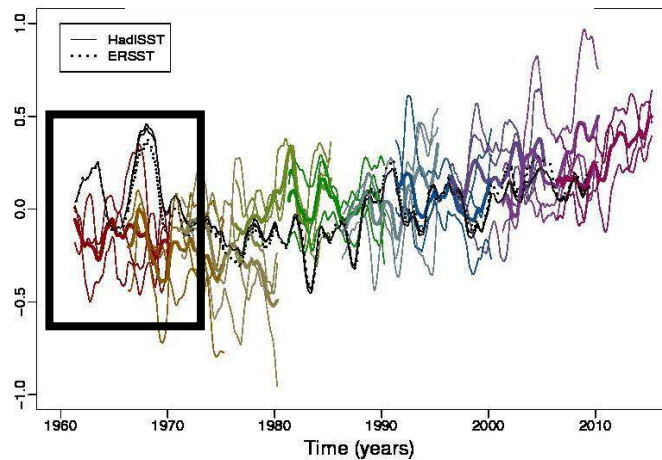
# Quels évènements majeurs manqués?

Sea Surface Temperature anomalies (155°E-235°E, 10°N- 45°N)

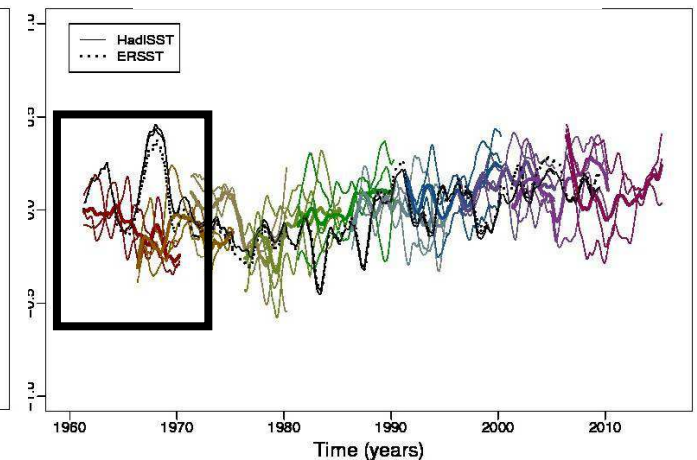
CNRM-CM3



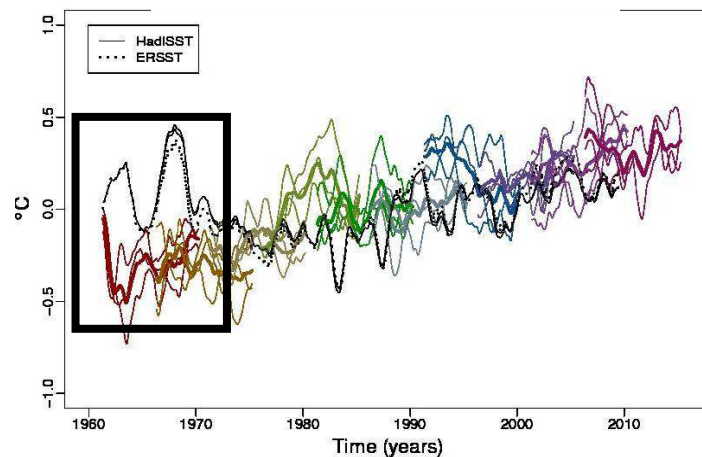
UKMO



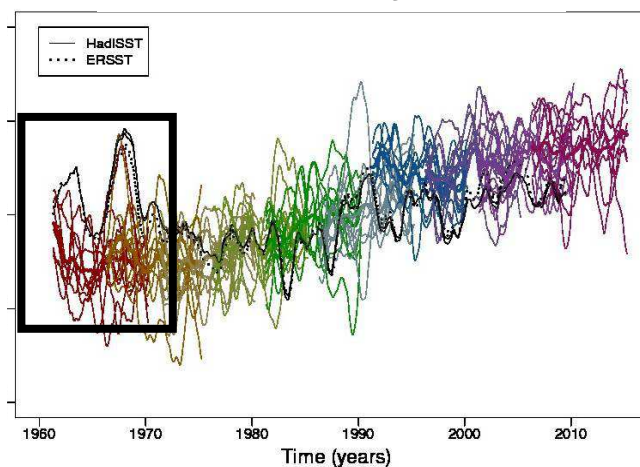
IFM-GEOMAR



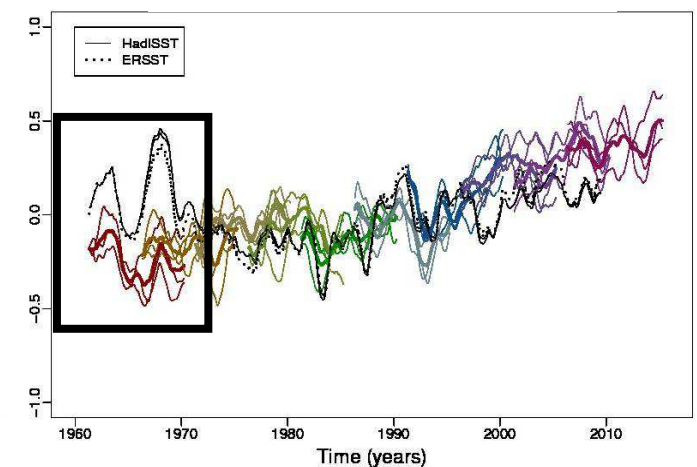
ECMWF



DePreSys



EC-Earth



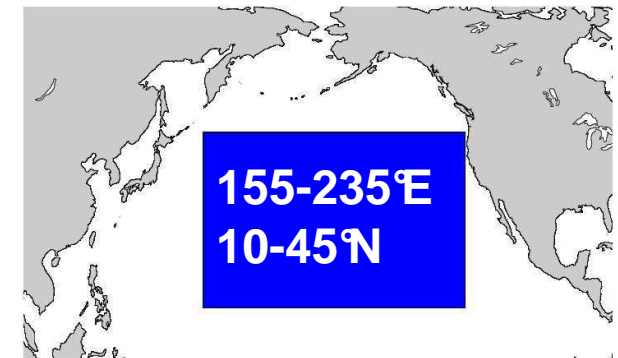
# Plan

- ✖ Liens avec des modes de variabilité connus ?**
- ✖ Mécanisme expliquant l'évènement de 1963**
- ✖ Mécanisme expliquant l'évènement de 1968**
- ✖ Cause possible de l'échec des systèmes de prévision**

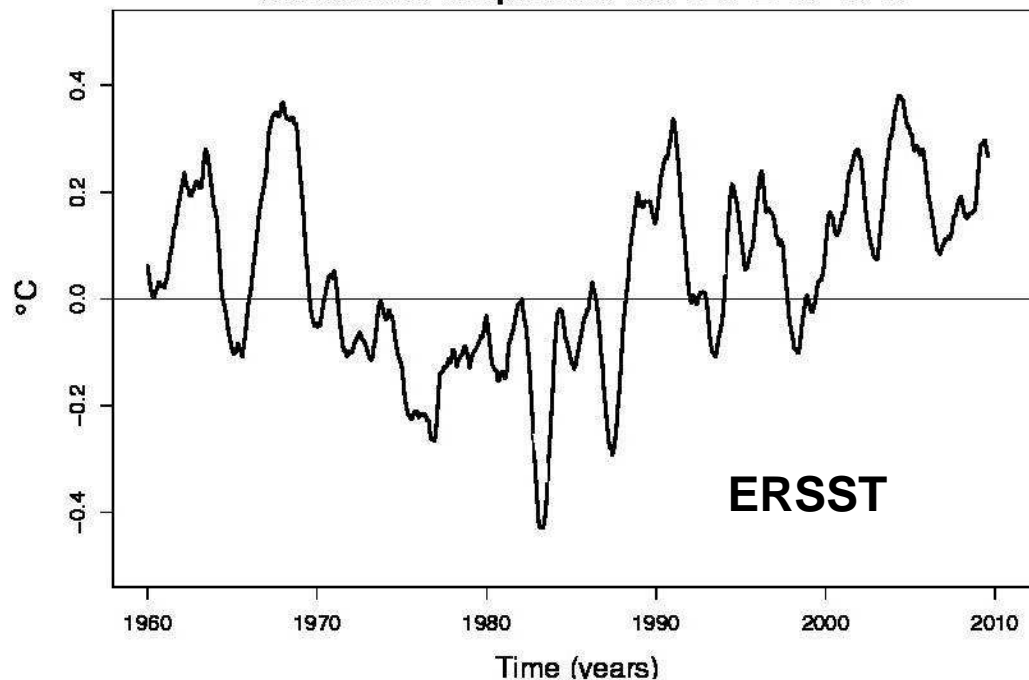
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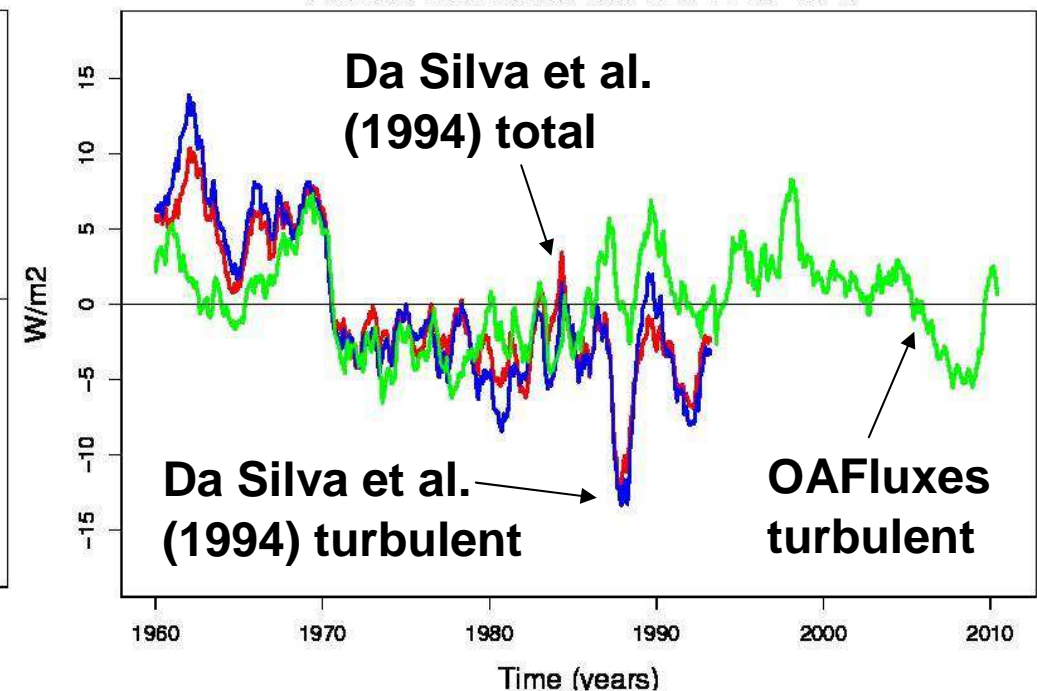
# Two major warmings in the North Pacific Ocean in 1963 and 1968



Sea Surface Temperature  
(155-235°E 10-45°N)



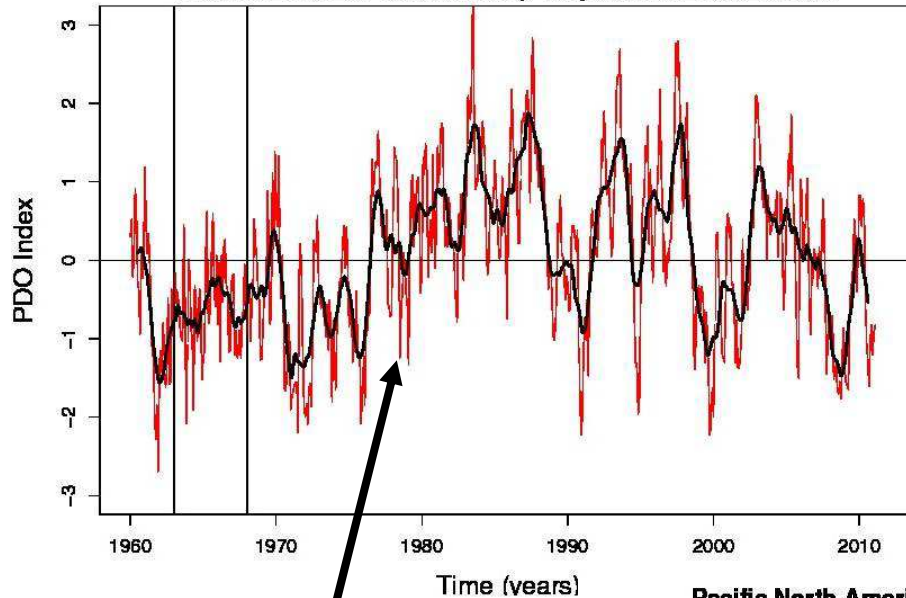
Upward surface heat fluxes  
(155-235°E 10-45°N)



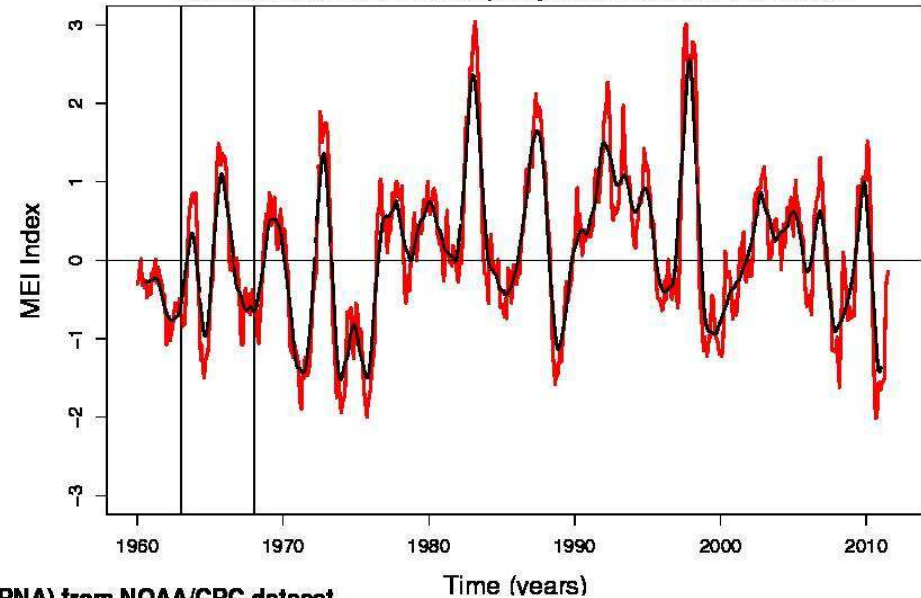


# No links with the main modes of variability

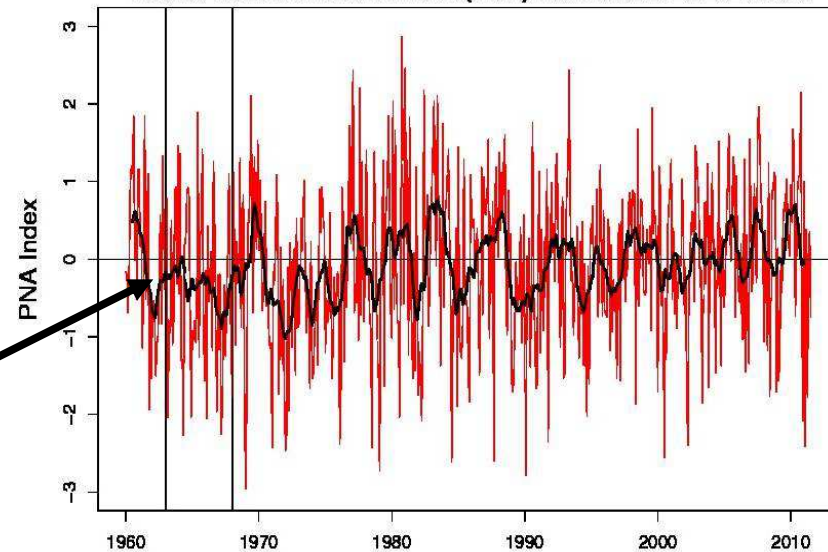
Pacific Decadal Oscillation (PDO) from JISAO dataset



Multivariate ENSO Index (MEI) from NOAA/PSD dataset



Pacific North American Index (PNA) from NOAA/CPC dataset



Monthly  
values

12-month  
running mean

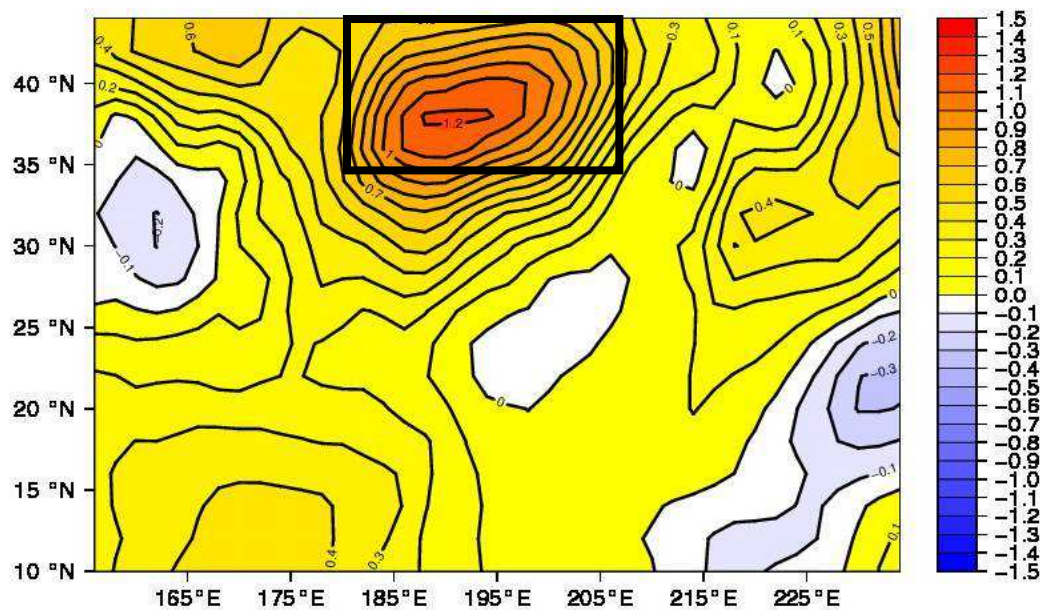
<http://www.esrl.noaa.gov/psd/data/climateindices/>

# Plan

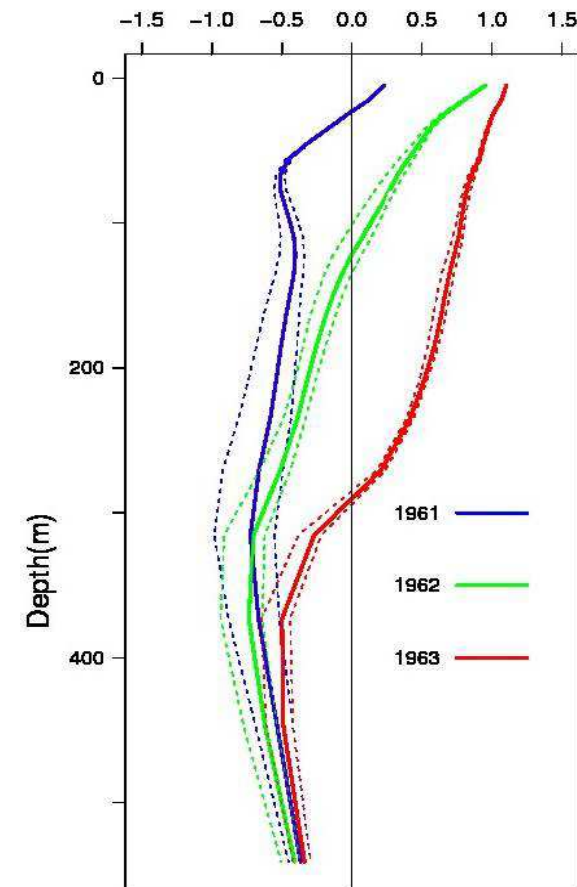
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# 1963: 3-dimensional structure of the anomaly

Pattern of ERSST anomalies  
(155-235°E 10-45°N)

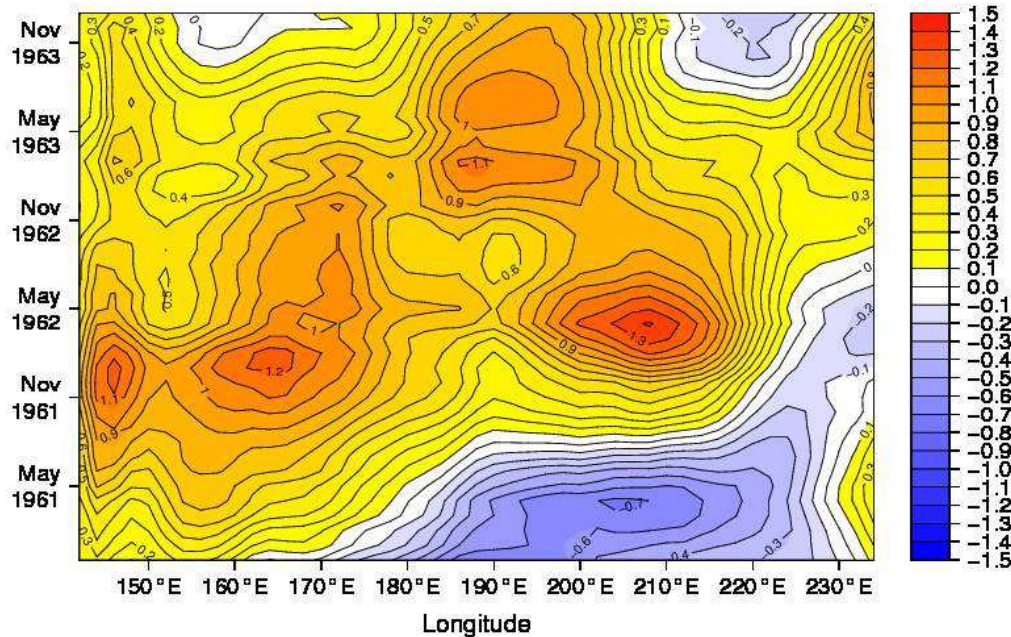


NEMOVAR temperature anomaly  
profile (180-205°E – 35-45°N)

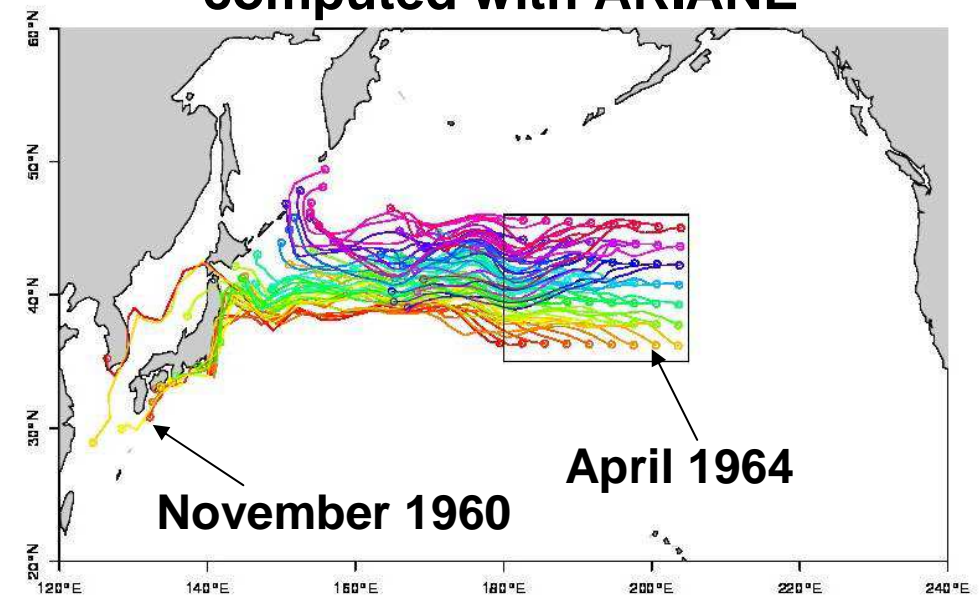


# 1963: advection of the anomaly

Hoevmuller ERSST anomalies  
( 35°N-45°N latitude band) °C



NEMOVAR backward trajectories  
computed with ARIANE



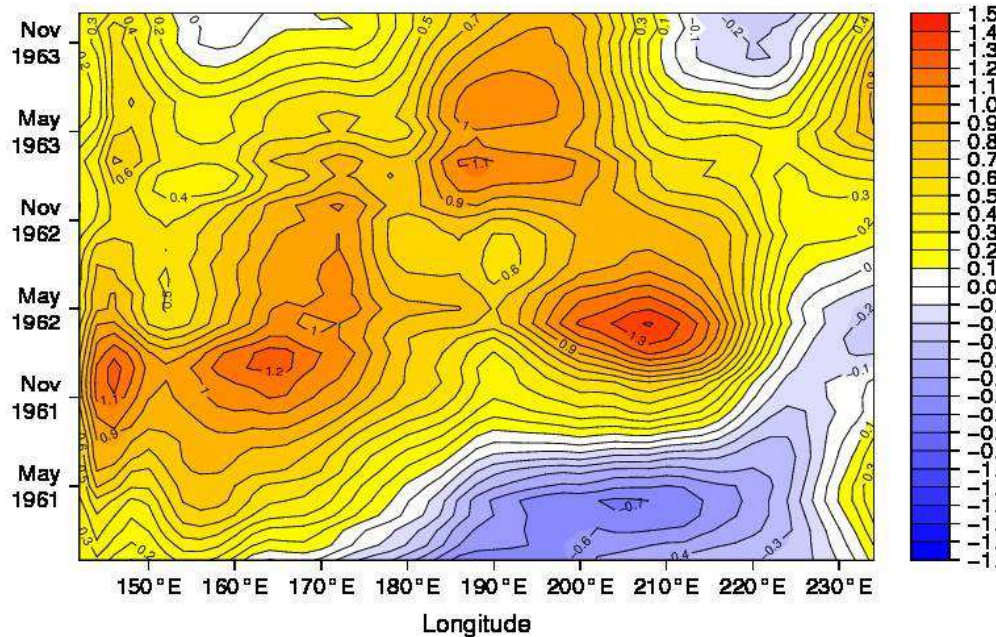
ARIANE

( <http://stockage.univ-brest.fr/~grima/Ariane/> )

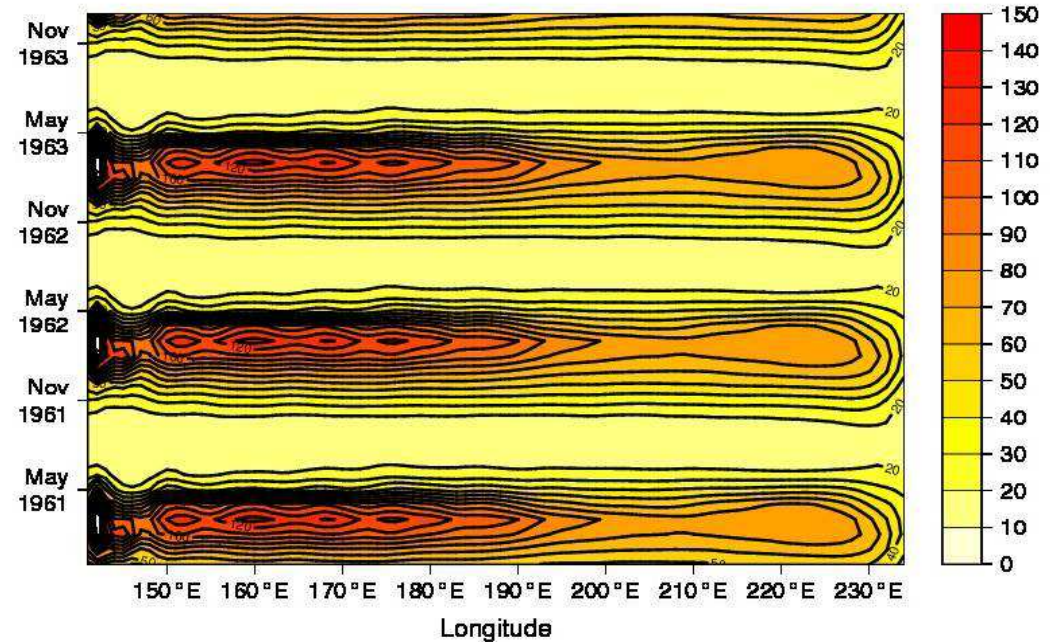


# 1963: modulation of the amplitude by mixing

**Hoevmuller ERSST anomalies  
( 35°N-45°N latitude band) °C**



**NEMOVAR climatological mixed layer  
depth ( 35°N-45°N ) m**

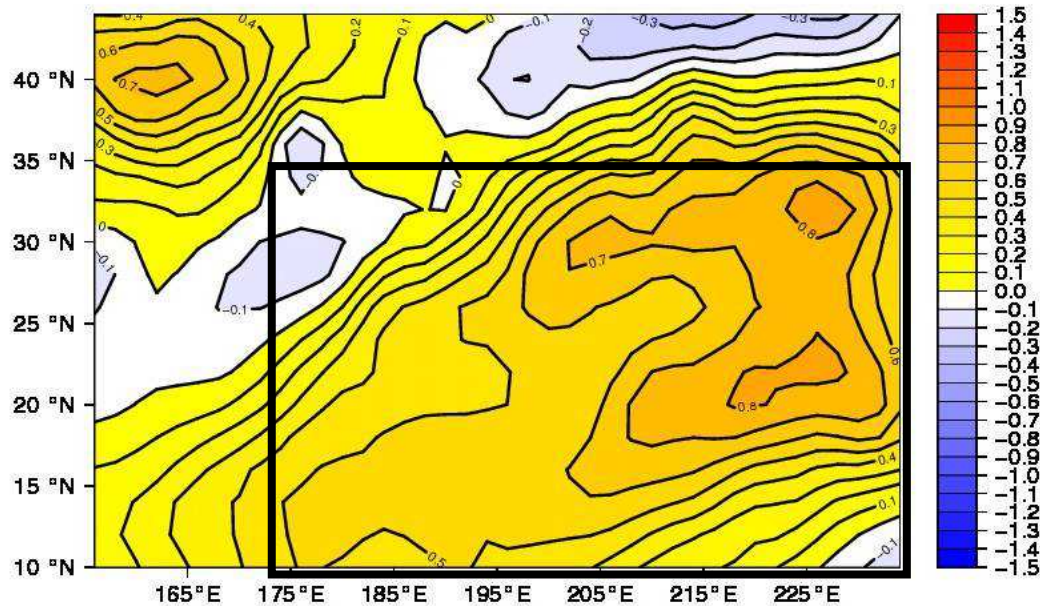


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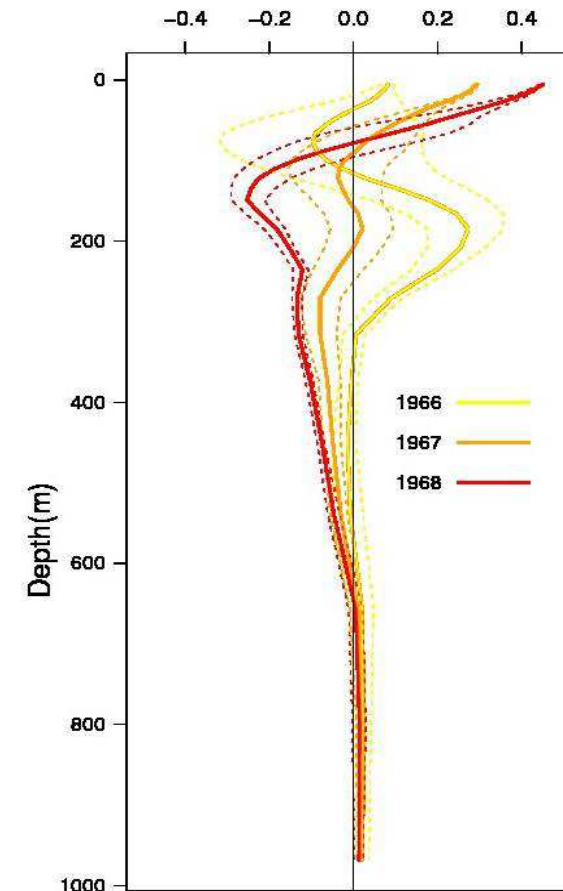
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# 1968: 3-dimensional structure of the anomaly

Pattern of ERSST anomalies  
(155-235°E 10-45°N)

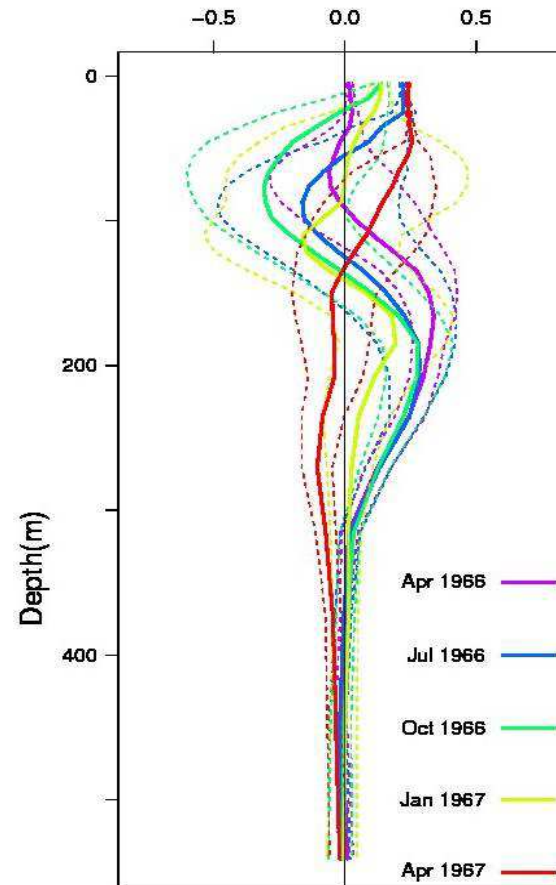


NEMOVAR temperature anomaly  
profile (170-235°E – 10-45°N)



# 1968: upward transfer of the anomaly

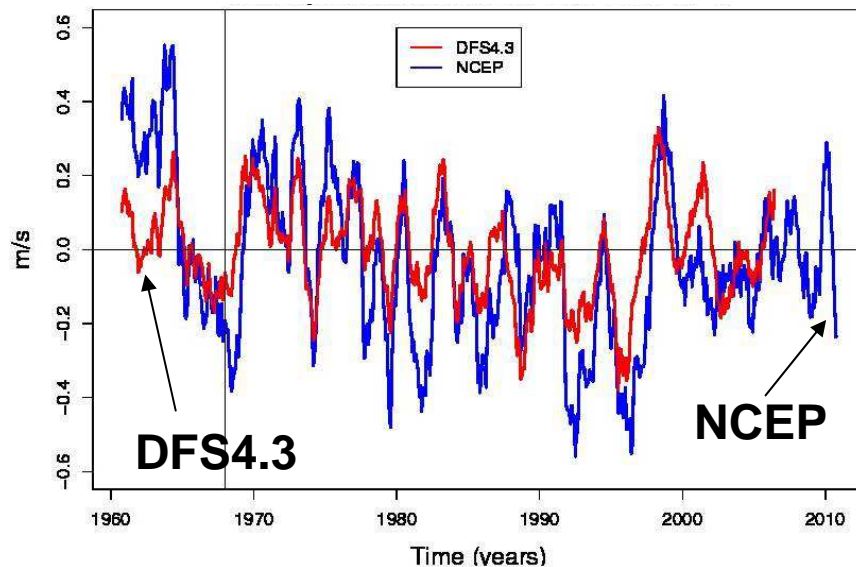
NEMOVAR temperature anomaly  
profile (170-235°E – 10-45°N)



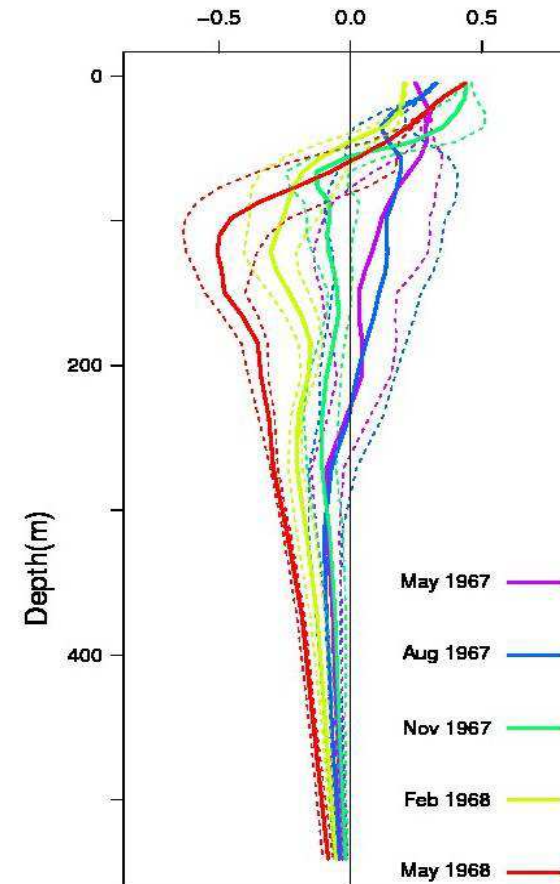


# 1968: amplification by the atmosphere forcing

Wind speed anomalies  
(170-235°E, 10-35°N)



NEMOVAR temperature anomaly  
profile (170-235°E – 10-45°N)



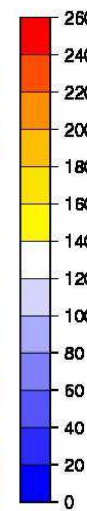
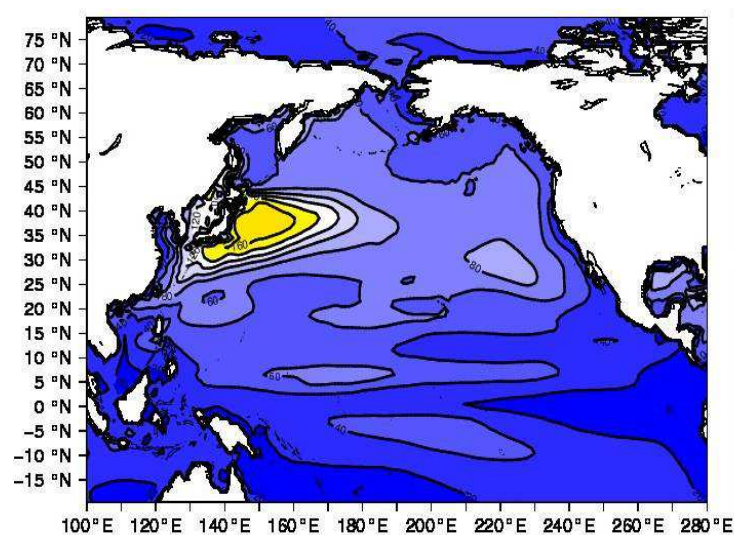
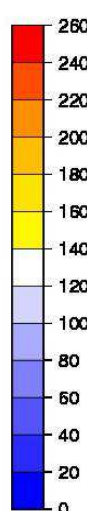
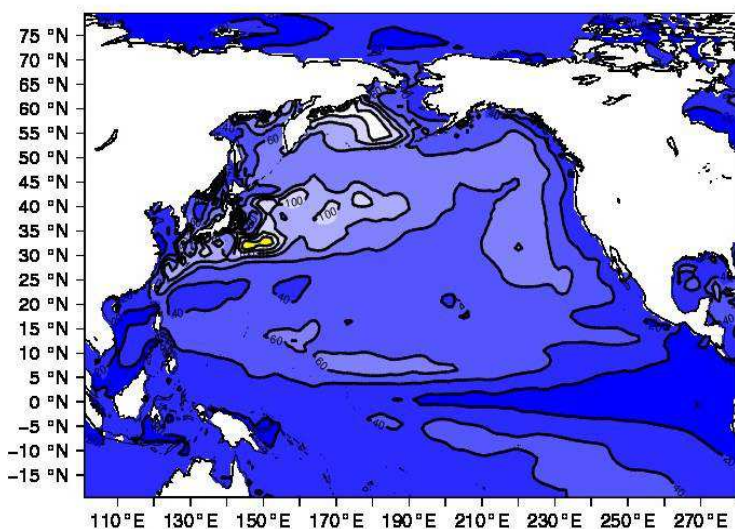
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# Stratification de l'océan Pacifique

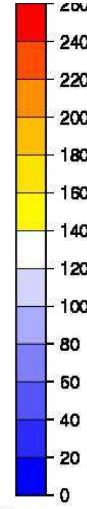
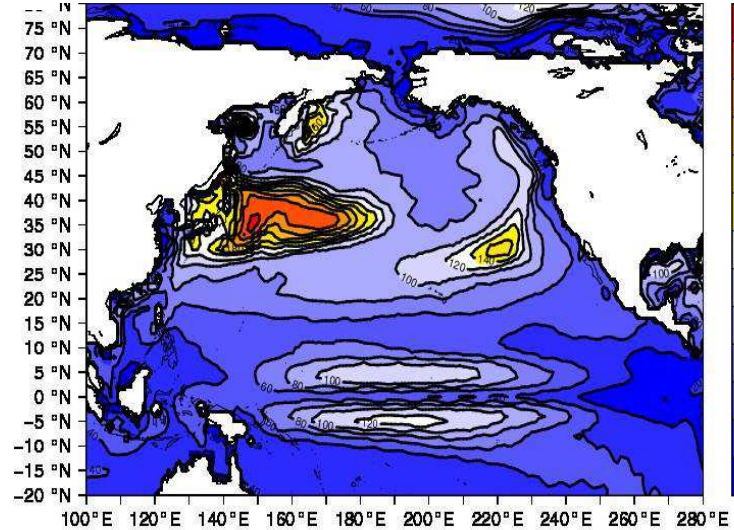
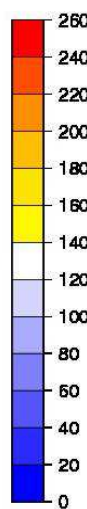
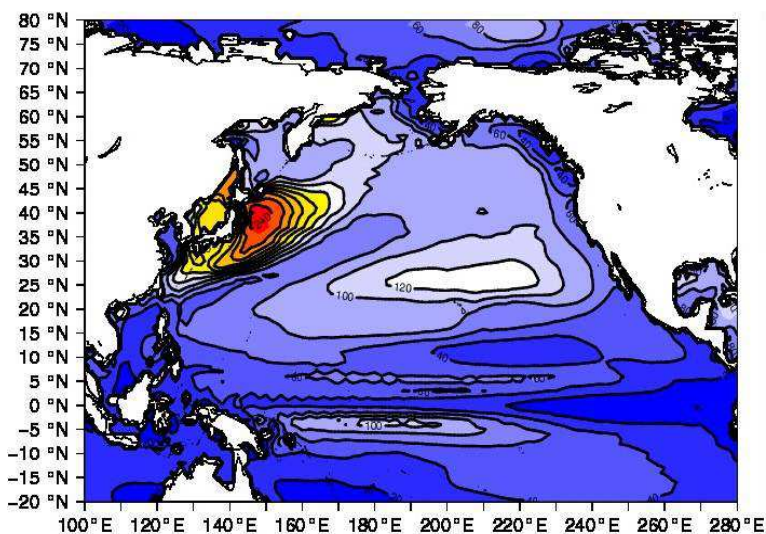
Profondeur de couche de mélange (critère densité) en m

NEMOVAR-COMBINE



EC-Earth v2

CNRM-CM3



IFM-GEOMAR

# Conclusion

- ✱ **Région Nord Pacifique = Région de plus faible scores dans les prévisions climatiques à court terme ( 2- 5 ans)**
- ✱ **Evènements majeurs autour de 1963 et 1968 manqués par tous les systèmes**
- ✱ **1963 : anomalie de chaleur advectée Kuroshio-Oyashio et confinée dans une couche de mélange de + en + fine**
- ✱ **1968 : anomalie upwellée puis amplifiée par le bruit atmosphérique**
- ✱ **Stratification de l'océan Pacifique mal représentée par les différents modèles de climat probablement en cause**